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ERTS PROGRESS REPORT

FOR THE PERIOD 1 OCTOBER 1973 TO 31 MARCH 1974

PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA

PROPOSAL NO. Y-10-066-001

BREVARD COUNTY PLANNING DEPARTMENT

TITUSVILLE, FLORIDA

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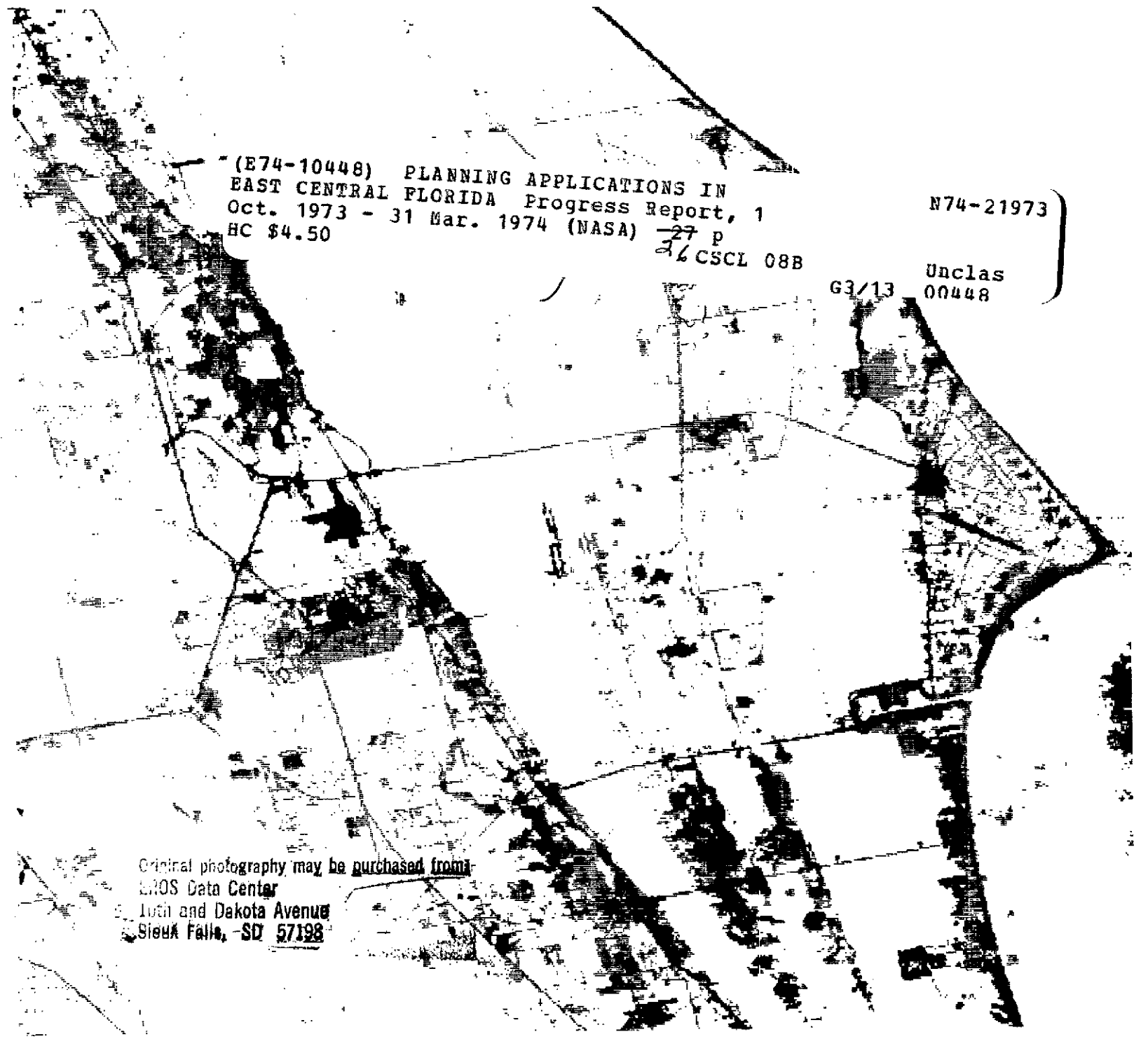

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PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA

PROPOSAL NO. Y-10-066-001

Principal Investigator: John W. Hannah*

Co-Investigators: Dr. Garland L. Thomas*
Ferd Esparza**

Computer Programming: James J. Millard**

*Brevard County Planning Department

**NASA, Kennedy Space Center

COMPUTER PROGRAMMING

Histogram Program

The histogram program, which heretofore could be applied only to rectangular sectors, has been revised so that it can be applied to a polygon of any shape. This increases its utility considerably, as it now can accommodate more accurately the shape of a city or other designated sector without requiring the division of the sector into an inconvenient number of rectangles. It thus facilitates the computation of the relative areas associated with the various classes.

In addition, the histogram program for ratios of two bands has been incorporated into the histogram program for single bands, so that the same program is used for both types of histograms.

Other Programs

The program which prints radiance values for designated sectors has been modified to printout data for more than one sector if the sectors are arranged vertically.

Several minor modifications have been made, mostly in format and headers.

CHARACTERISTICS OF CITIES

Residential Chracteristics

It has been found that, in some cases, computer mapping of the ratio of two ERTS MSS bands can distinguish between older residential areas with appreciable numbers of good-sized, deciduous trees and newer residential areas with fewer trees. This point is illustrated in Figure 1, which is a map of the ratio of band 7 radiance to band 5 radiance. Region 1 is an older section with more and larger deciduous trees than the newer sector 2. Sector 3 also is newer and has fewer trees. This characteristic for these sectors can be seen also in photographs, Figure 2 and 3.

CHANGE MONITORING

MSS digital tapes have been received for two essentially cloud-free passes for this region. An attempt is underway to evaluate the digital data for use in monitoring urban change by comparing density-sliced and band ratio maps made from the two sets of data.

The two dates are September 6, 1972 and April 28, 1973, giving an interval of approximately eight months.

Due apparently primarily to differences in atmospheric conditions, the radiance values were significantly higher for the second pass. The method used to normalize the data was to make the choice of character levels for mapping the second set of data such that certain commercial regions which were known to have remained relatively constant during the

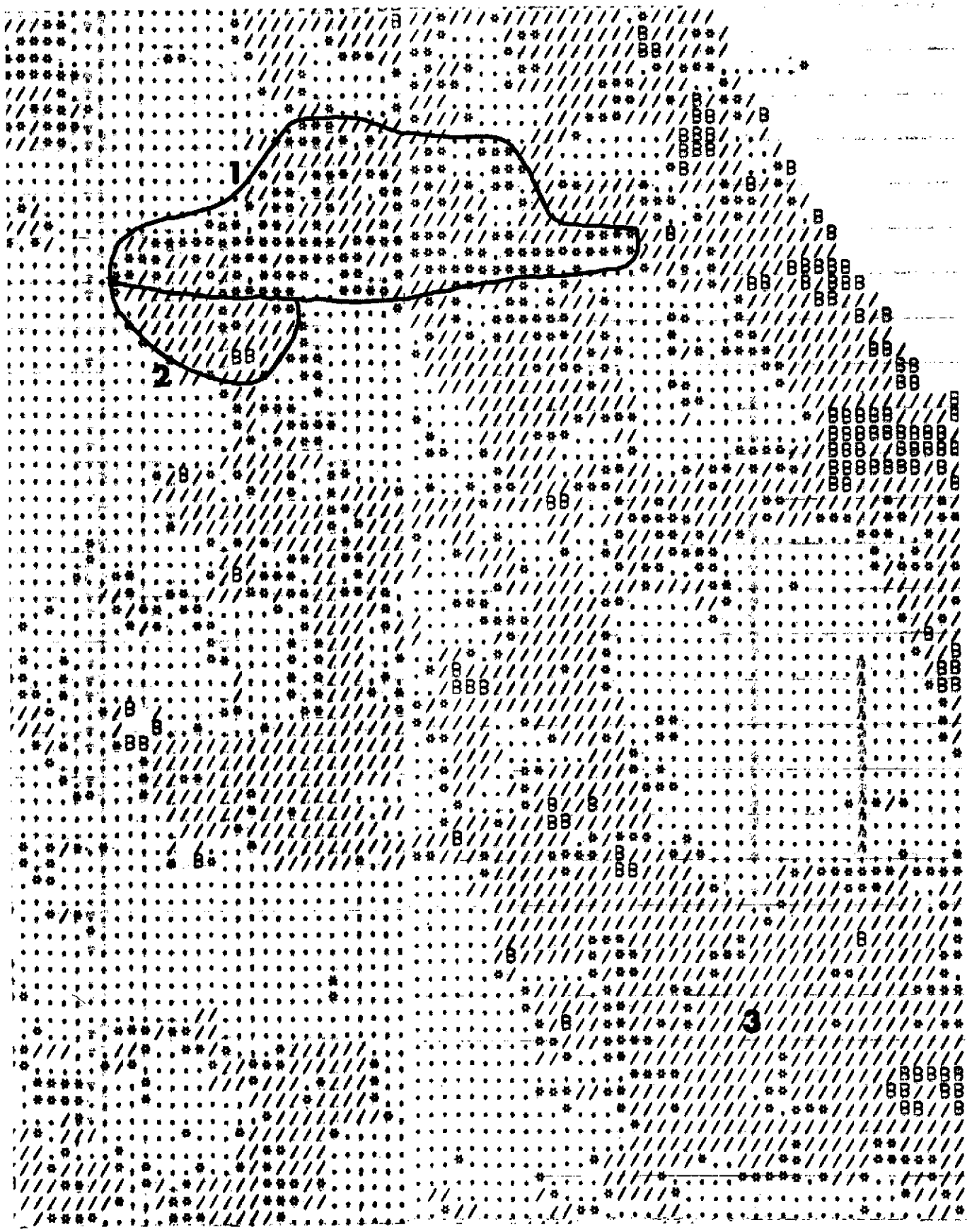

Figure 1

Figure 2

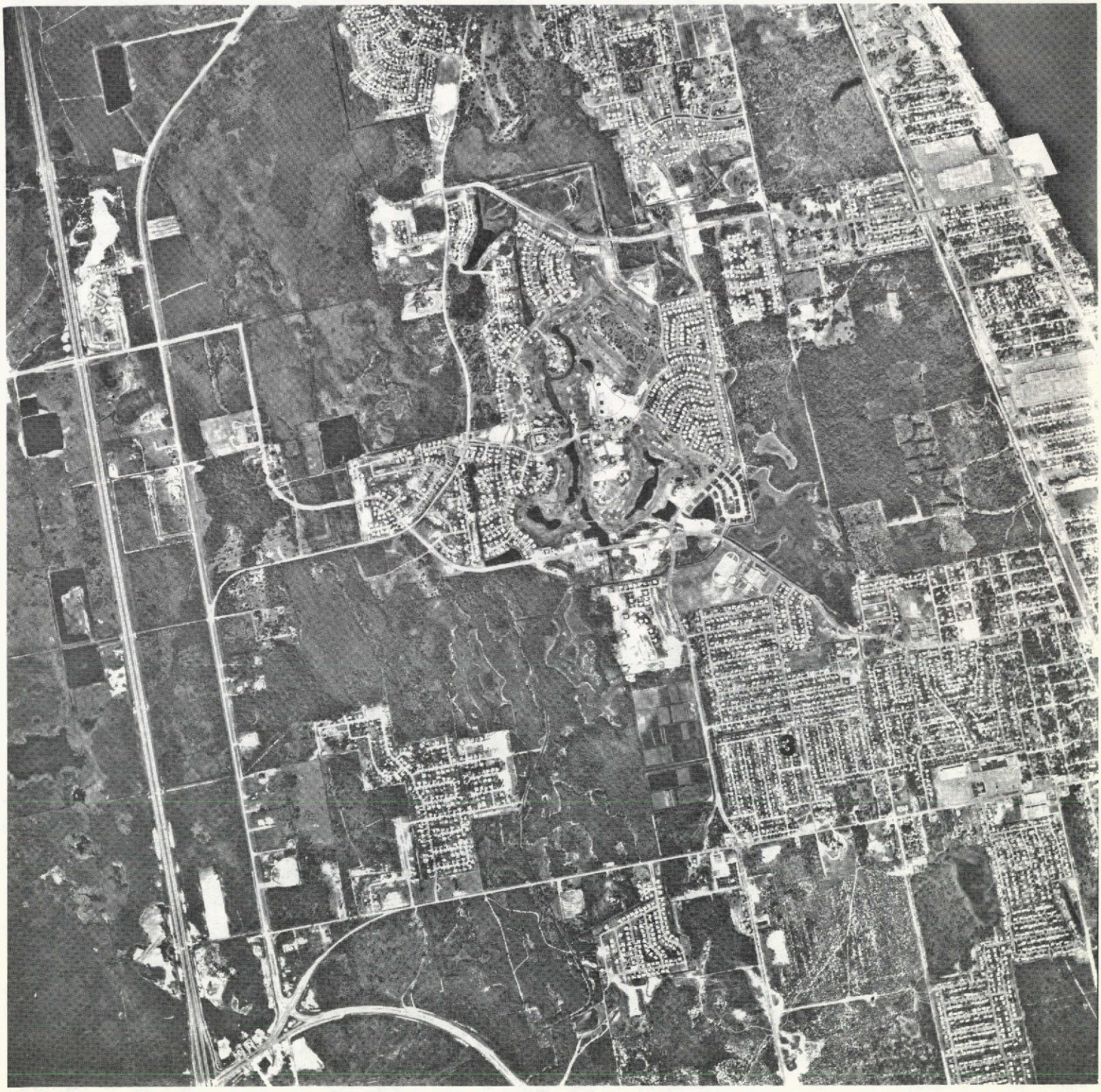

Figure 3

period appeared the same (same characters and same area) on the second map as on the first.

Due to differences in locations of the viewed resolution elements on the different passes, at least, there will be minor differences in the computer maps even where there have been no changes in the scene, so that a change of one character, for example, on the map often is not significant; but, as a rule of thumb, a change of two or more characters usually is significant and should be checked.

Titusville

Because Titusville is the area which has been most thoroughly studied by us, it was used as the sector for the first attempt at change monitoring. Two types of map were used in making the comparison: band 5 density and the ratio of bands 7/5.

The results described below use the combined information available from the two types of maps; some of the changes were observable on one of the map types, some on the other, and some on both.

Certain obvious changes are readily observable (For reference purposes, we shall refer to them as Class A changes):

(1) construction of a new motel

(2) grading associated with construction of a new high school

(3) grading at an industrial park

(4) construction of 3 single-family houses adjacent to each other

(5) construction of 2 single-family houses adjacent to each other

(6) construction of a new single-family house

(7) street construction

(8) sand quarry in initial stage of development.

Most of these changes caused a change in several map characters (resolution elements).

A check with the City Building Department indicated several other construction projects which had some activity during the period under consideration. These locations were checked against the computer maps with the following results (Call these Class B changes.):

(9) enlargement of parking lot -- in central business district -- not distinguishable on ERTS maps

(10) construction of church -- small -- one lot -- believed seen on ERTS map

(11) construction of addition to school -- seen on ERTS maps but not noticed as Class A because it is adjacent to a shopping center

(12) 8 new single-family houses in a single subdivision -- scattered -- not observed on ERTS maps

(13) condominium additions -- observable on ERTS maps

(14) condominium construction -- observable on ERTS maps

(15) 5 single-family residences in the same general area -- observable on ERTS maps

(16) 9 single-family houses in same addition but mostly scattered -- not observed on ERTS maps

(17) 3 single-family homes adjacent to each other -- not observed on ERTS maps

(18) construction of small commercial building -- not observed on ERTS maps

(19) 6 single-family homes in same general area -- observable on ERTS maps

(20) construction of a small commercial building -- possibly observable

on ERTS maps but indistinguishable from (7)

(21) construction of 4-unit condominium -- observable on ERTS map

(22) addition to condominium -- not observable on ERTS maps

(23) construction of small commercial building -- observed on ERTS maps

(24) construction of an additional building in an industrial complex located on bare sand -- not observed on ERTS, as the complex and surrounding sandy area already showed a maximum level of radiance.

It will be noted that of the sixteen Class B changes, nine were observable on the ERTS maps. With more careful analysis, they could, then, have been detected from the ERTS maps, followed by ground checking; however, such a procedure would involve checking out a comparable number of "false leads." The remaining six Class B changes could not be detected by the ERTS analysis techniques used by us to date.

An observation at this point is that major changes can be detected almost automatically but the monitoring of minor changes by density-sliced mapping and band ratio mapping is not yet an automatic process. Results to date indicate that, when supplemented by appropriate ground checking, it can be a useful tool. At least, further experimentation and development of techniques is justified. More careful character-by-character comparison of corresponding maps might improve the accuracy. Maximum likelihood classification techniques, which we intend to apply at a future date, may result in increased effectiveness.

Figure 4 shows the locations of the changes observed on the ERTS maps as described above.

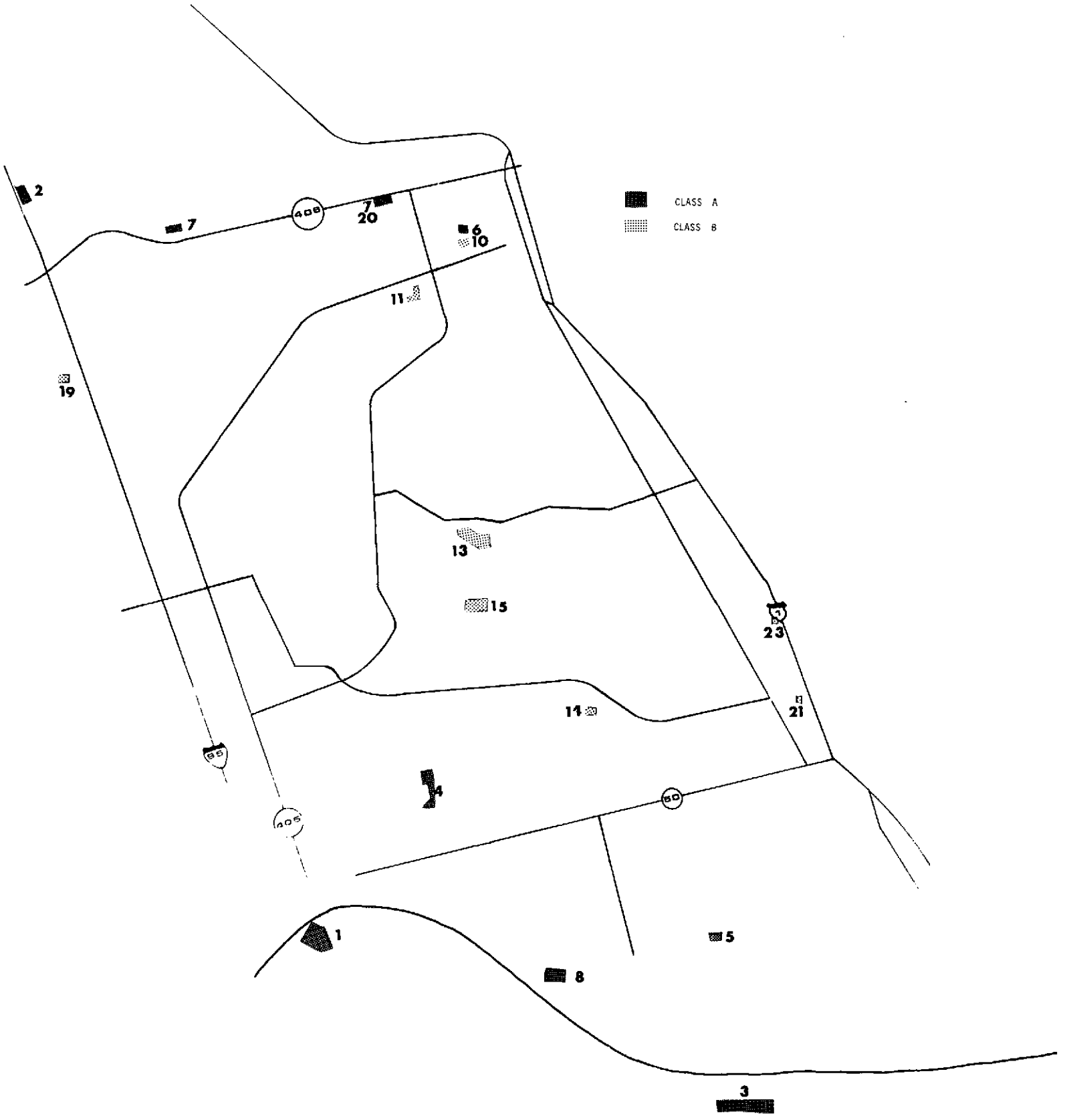

Figure 4

Disney World Impact

One of the objectives of this project is the application of change-monitoring techniques to commercial development in the Disney World vicinity.

Preparation of a tracing on an overlay was used to indicate commercial areas for the first date and changes which appeared between the two dates. All significant, new developments are believed to be shown, but some extraneous ones appear on the computer maps. For the most part, these were found to be newly cultivated citrus groves. With appropriate ground checking to eliminate such spurious effects, this method appears to be a useful tool.

This proecdure has been completed for two regions: (1) that immediately surrounding Disney World and (2) east of Disney World. The results for the Disney World region are shown in Figure 5.

The features which were found to have been added in that region between the two dates have been identified as follows:

1. New road under construction
2. New residential development
3. Addition to existing motel
4. New parking lot
5. Land graded for new mobile home park
6. Hotel construction
7. Construction of townhouses
8. New mobile home area
9. New residential construction in existing residential development
10. Addition to existing residential development.

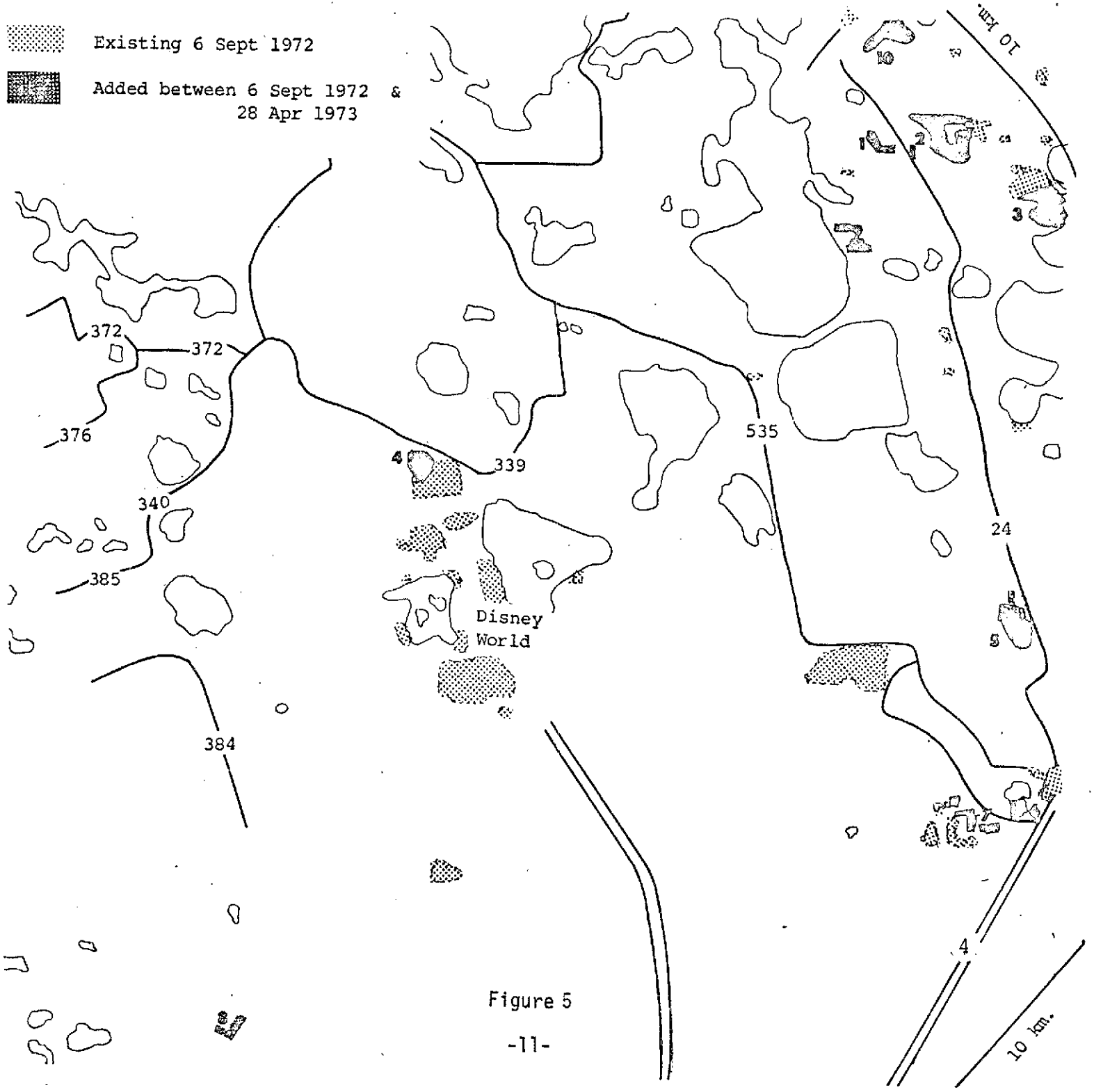
Existing 6 Sept 1972
Added between 6 Sept 1972 & 28 Apr 1973
372
372
376
340
385
384
339
535
24
Disney World
10 km.
10 km.

Figure 5

It is possible to count characters and thereby obtain areas and percentage changes, but caution must be used in interpretation. In this case, for example, housing under construction shows as new, while existing, scattered housing in this non-urban setting is difficult to detect. Commercial development, however, can be evaluated fairly accurately. Within this period, for example, this method shows an increase of 12% in "built up" area within Disney World. Outside Disney World, the figures are:

	Old	New	Increase
Commercial	26.0 ha	8.2 ha	32%
Road Construction	-	3.5	
Housing Construction	10.8	19.1	
Mobile Home Construction	3.0	11.3	

The map for the sector east of Disney World is shown as Figure 6. New features are identified as follows:

11. multi-family residential
12. fill
13. addition to mobile home park
14. commercial
15. commercial
16. mobile home park
17. commercial
18. commercial
19. industrial
20. industrial

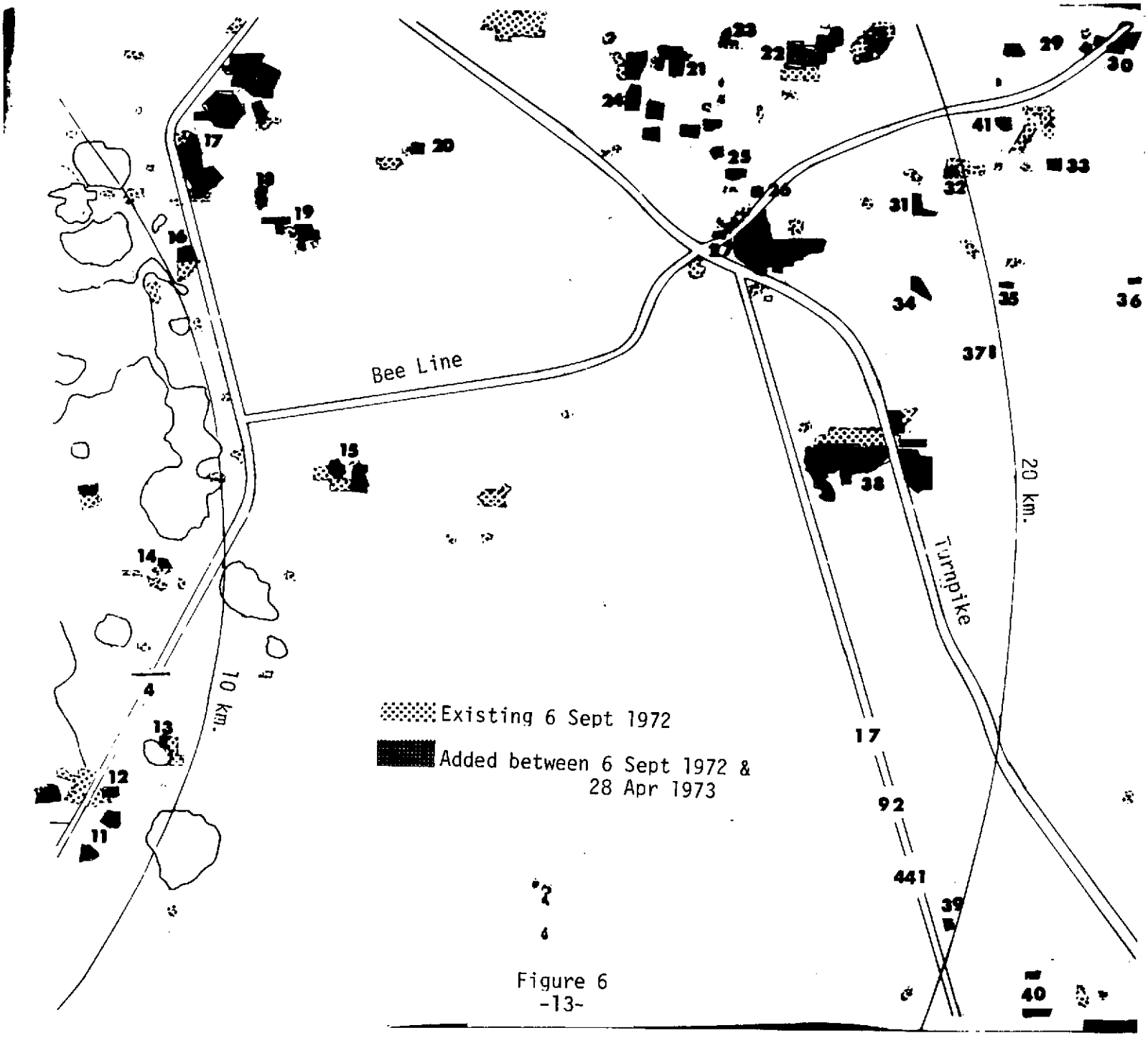
Bee Line
10 km.
20 km.
Turnpike
Existing 6 Sept 1972
Added between 6 Sept 1972 & 28 Apr 1973
17
92
441

Figure 6

21. commercial

22. residential (mostly single-family)

23. commercial

24. industrial

25. commercial

26. industrial

27. commercial

28. industrial

29. commercial

30. commercial

31. industrial

32. industrial

33. industrial

34. industrial

35. industrial

36. land clearing

37. industrial

38. industrial

39. industrial

40. single-family residential

41. industrial

Area tabulations are:

	Old	New	Increase
Commercial	85 ha.	286 ha	336%
Industrial	183	225	123
Housing Construction		42	
Mobile Home Construction		7	

The two sectors combined are shown as Figure 7.

Combined area tabulations are:

First 10 KM.[1]

	Old	New	Increase
Commercial	37 ha.	11 ha.	30%
Housing Construction		19	
Mobile Home Construction		16	

Between 10 and 20 KM.[1]

	Old	New	Increase
Commercial	99	279	282
Industrial	134	211	157
Housing Construction		58	
Mobile Home Construction		18	

Beyond 20 KM.[1]

	Old	New	Increase
Commercial	1	11	
Industrial	27	9	
Housing Construction		3	
Mobile Home Construction			

[1]Measured from Disney World Magic Kingdom

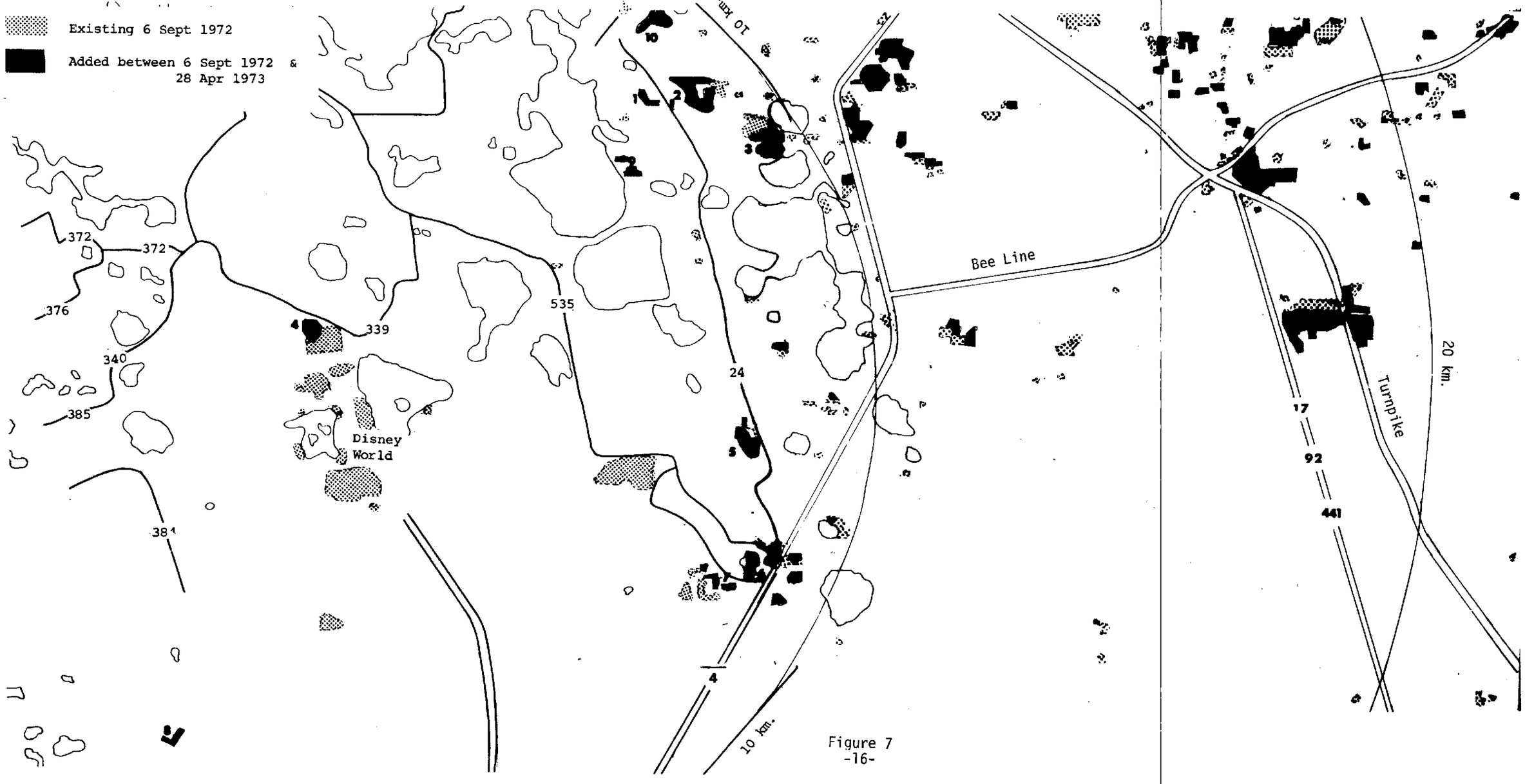

Figure 7

FOLDOUT FRAME 1

FOLDOUT FRAME 2

Total

	Old	New	Increase
Commercial	137 ha.	301 ha.	220%
Industrial	101	220	137
Housing Construction		80	
Mobile Home Construction		34	

CHARACTERISTICS OF CITIES

Lakeland

Both ERTS and EREP data have been obtained for the Lakeland region, enabling comparisons of the utility of the two data types. Noise in the EREP MSS output limits its usefulness, but the EREP photography and computer maps from the ERTS MSS digital data provide more useful information, as shown by the land use maps based on the two sets of data, respectively, Figures 8 and 9. The classification system, Table 1, is a slight modification of the Anderson, Hardy, Roach System[2] and is given in Table 1. A general land use map of the city used by state highway planners is shown for comparison (Figure 10)[3]. Both the EREP and the ERTS maps were prepared without ground truth observations except for reference to Figure 10. Significantly more detail is provided by the photography than by the digital data. There are, of course, compensating advantages to the digital data, in addition to the relative ease of obtaining it and its repetitive nature: for example, suitability for

[2]James R. Anderson, ERnest E. Hardy, and John J. Roach
A Land-Use Classification System for Use with Remote-Sensor Data
Geological Survey Circular 671

[3]1970 Land Use and Highway Functional Classification System,
State of Florida

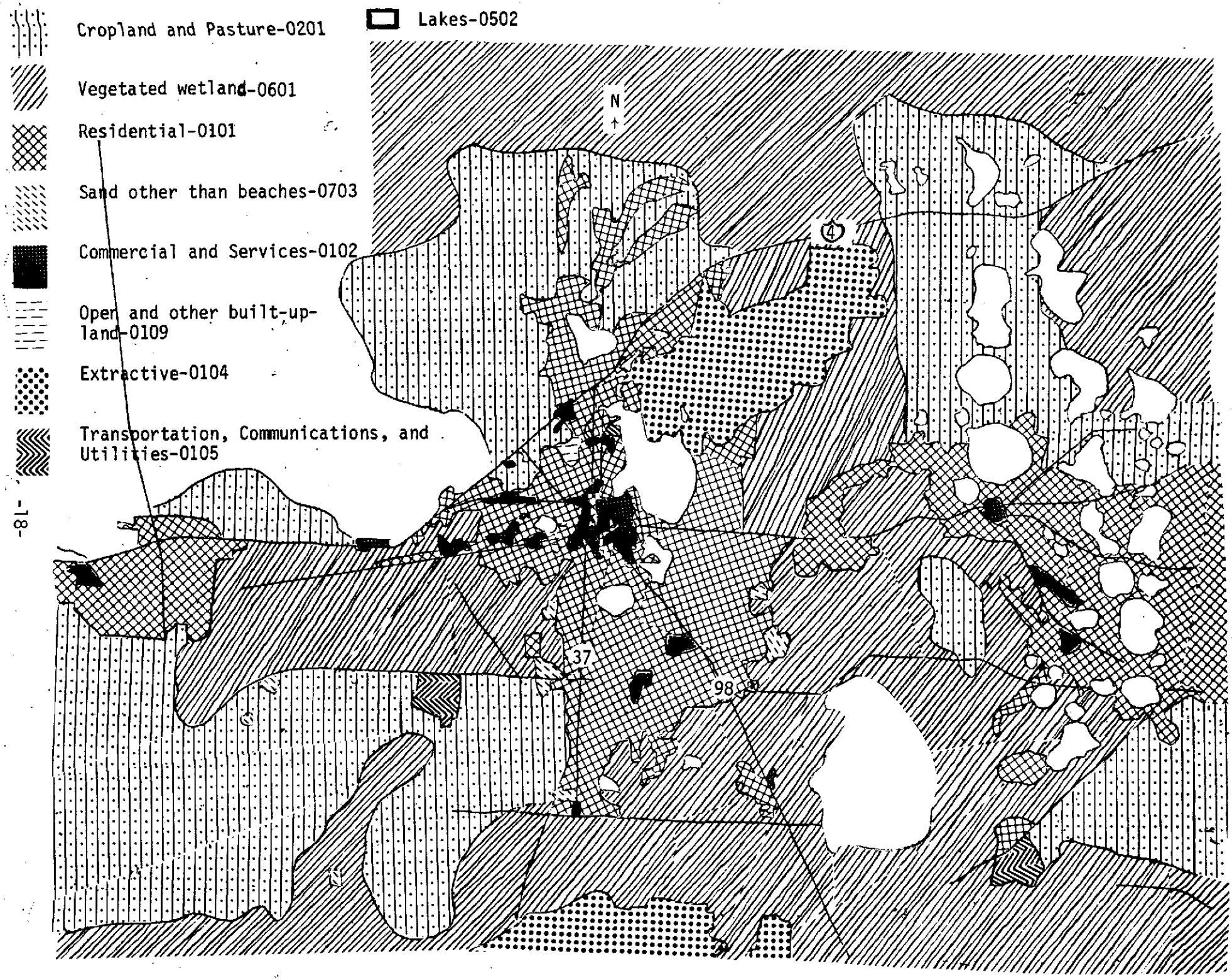
Cropland and Pasture-0201
Lakes-0502
Vegetated wetland-0601
Residential-0101
Sand other than beaches-0703
Commercial and Services-0102
Open and other built-up-land-0109
Extractive-0104
Transportation, Communications, and Utilities-0105
N
4
37
98

Figure 8

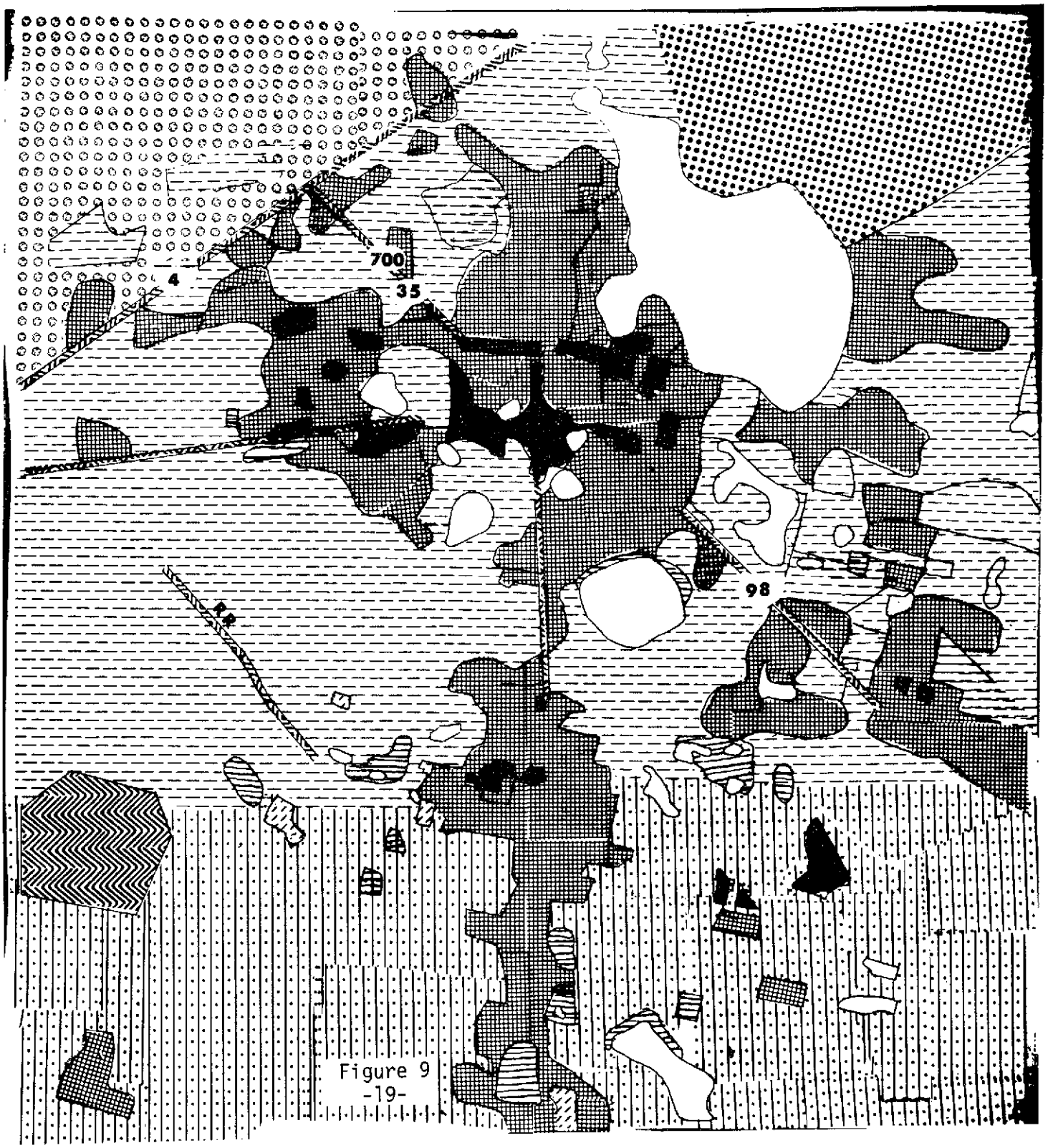

Figure 9
-19-

TABLE 1

LAND-USE CATEGORIES:

1st Pair of Digits	2nd Pair of Digits
01. Urban and built-up land	01. Residential 02. Commercial and services 03. Industrial 04. Extractive a. Phosphate mines 05. Transportation 07. Strip 09. Open
02. Agricultural land	01. Cropland and pasture a. Muck farms (vegetables) 02. Groves a. Primarily citrus
03. Rangeland	01. Grass
04. Forest Land	01. Deciduous 02. Evergreen (pine) 03. Mixed
05. Water	01. Streams and waterways 02. Lakes 05. Other (Gulf of Mexico)
06. Nonforested Wetland	01. Vegetated 02. Bare
07. Barren Land	03. Sand other than beaches

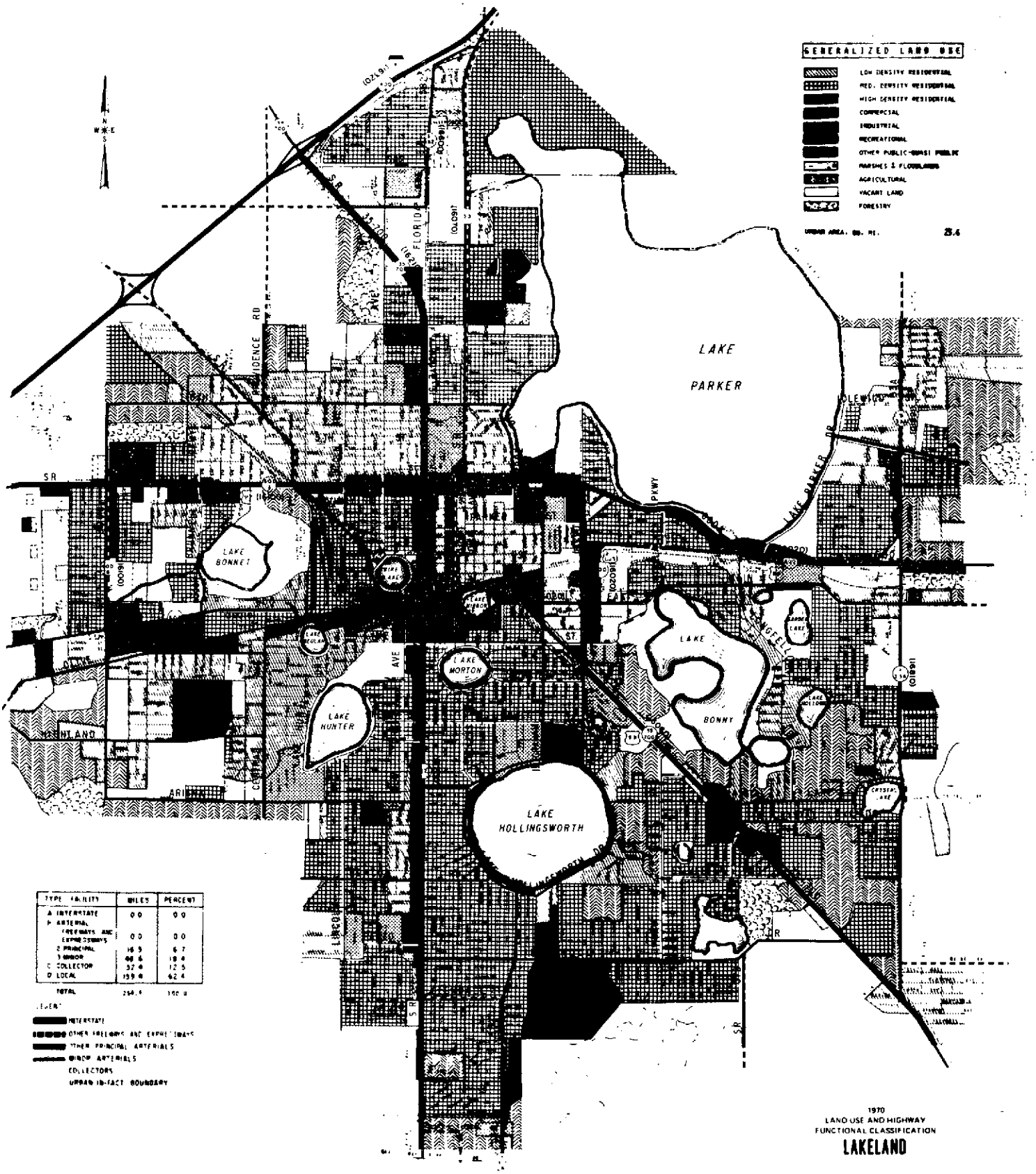
GENERALIZED LAND USE
LOW DENSITY RESIDENTIAL
MED. DENSITY RESIDENTIAL
HIGH DENSITY RESIDENTIAL
COMMERCIAL
INDUSTRIAL
RECREATIONAL
OTHER PUBLIC-QUASI PUBLIC
MARSHES & FLOODLANDS
AGRICULTURAL
VACANT LAND
FORESTRY
LAKE PARKER
LAKE BONNET
LAKE MORTON
LAKE HUNTER
LAKE BONNY
LAKE HOLLINGSWORTH
FLORIDA AVE
PROVIDENCE RD
LAKE PARKER PKWY
SR
TYPE FACILITY
MILES
PERCENT
A INTERSTATE
B ARTERIAL
FREEWAYS AND EXPRESSWAYS
2 PRINCIPAL
3 MINOR
C COLLECTOR
D LOCAL
TOTAL
INTERSTATE
OTHER FREEWAYS AND EXPRESSWAYS
OTHER PRINCIPAL ARTERIALS
MINOR ARTERIALS
COLLECTORS
URBAN IN-FACT BOUNDARY
1970
LAND USE AND HIGHWAY
FUNCTIONAL CLASSIFICATION
LAKELAND

Figure 10

thematic mapping.

Comparison of the figures shows that both the EREP and the ERTS maps give reliable indications of commercial-industrial regions and that the EREP photography gives a good pattern of the residential region but that the ERTS map, as prepared by us in this case, underestimates the residential region. This underestimation may be correctable by appropriate use of ground information. Ground checking, including checking of aerial photography, will be the next step in our procedure.

Phosphate mines show clearly in both types of data and can be monitored readily by satellite.

Use of computer-mapping to produce a thematic map directly is illustrated by Figure 11, which is a map of the ERTS data (band 5) for Lakeland intended to show commercial-industrial and high-intensity residential sectors.

LAKES

Lake Apopka and three lakes into which it drains, located in the central part of the state, have been in advanced stages of eutrophication for several years. In ERTS images, these lakes consistently show distinctive coloration relative to other lakes: they have higher reflectivity in bands four and five. This effect shows up in mapping of band four density and can be observed quantitatively by printing out the radiance values for band four.

This effect also shows up in EREP photography.

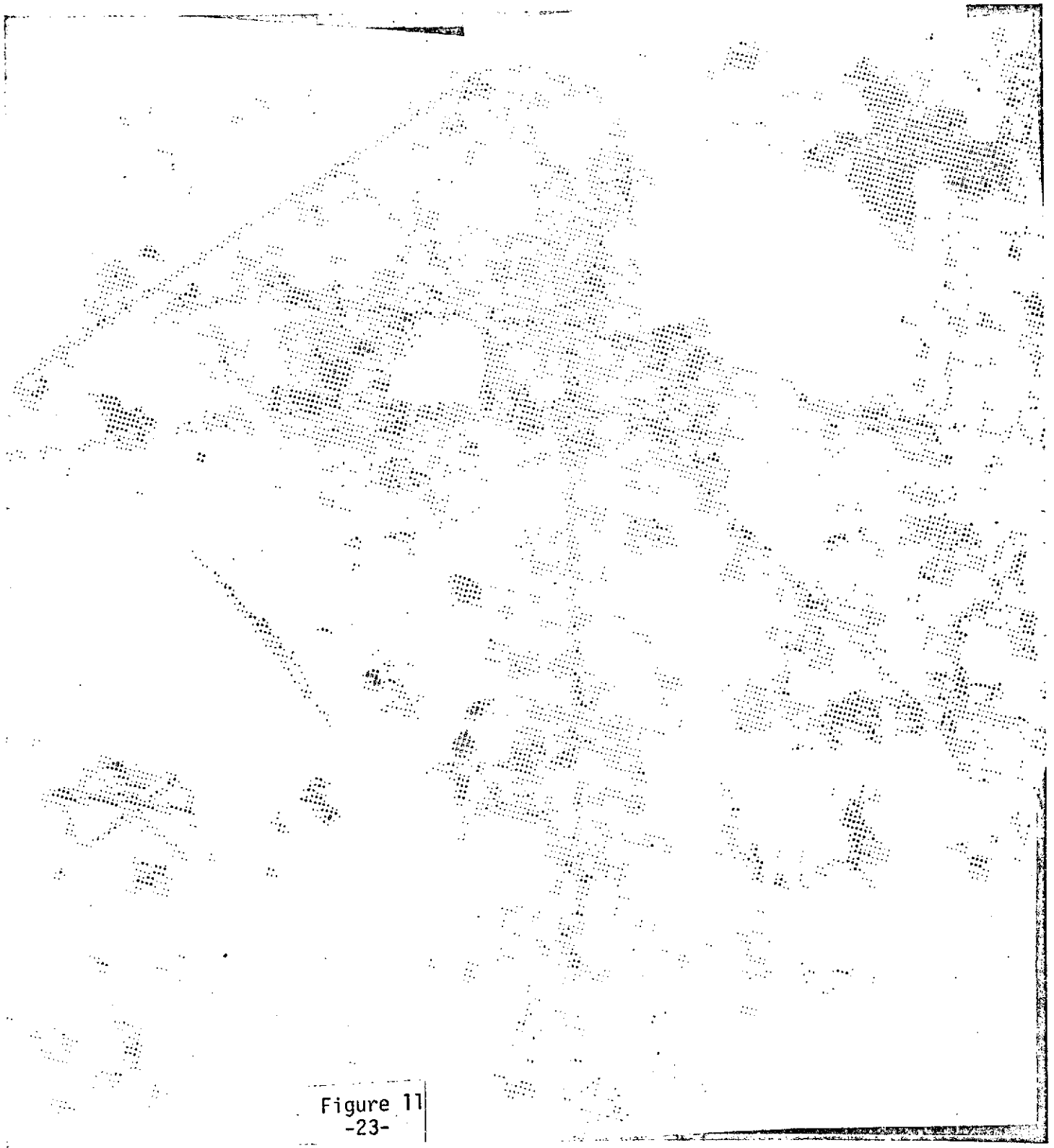

Figure 11
-23-

In an attempt to evaluate this effect and relate it to water parameters associated with eutrophication, discussions are being held with Florida Game and Fresh Water Fish Commission personnel at Eustis concerning their information on these lakes and their sampling and water analysis data. Development of a sampling and laboratory analysis program coordinated with ERTS passes is under consideration.